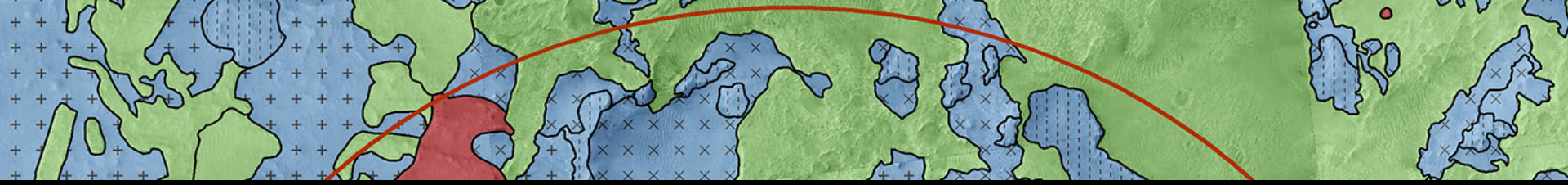
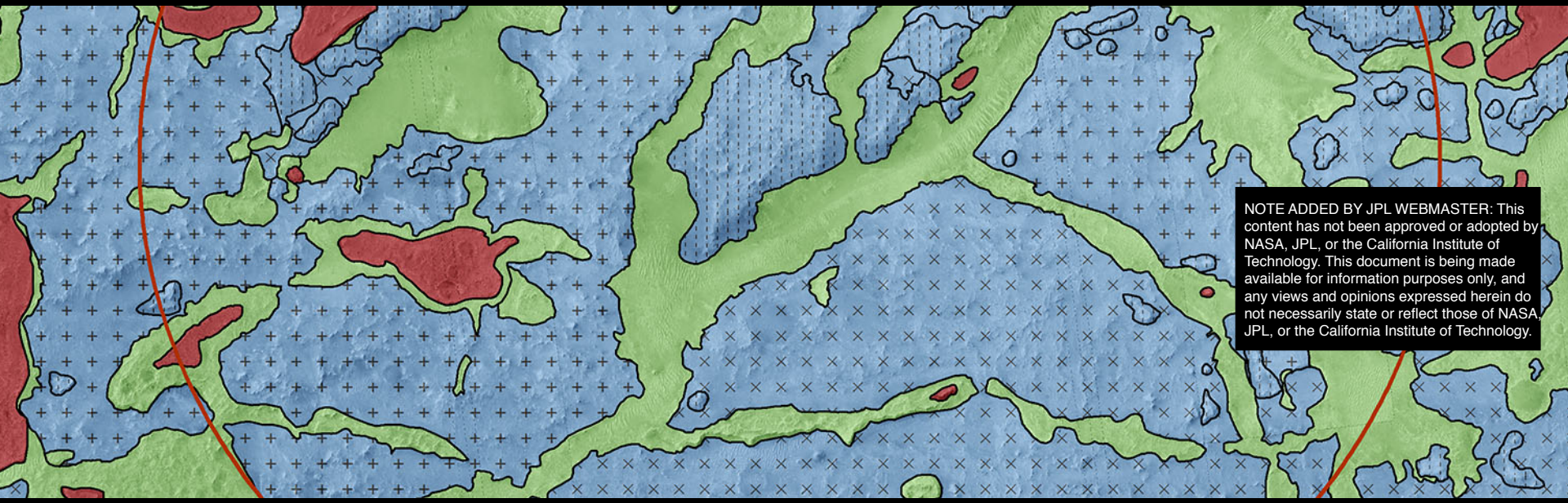


Geological Continuity Between the Midway and NE Syrtis Candidate Landing Sites for the Mars 2020 Rover Mission



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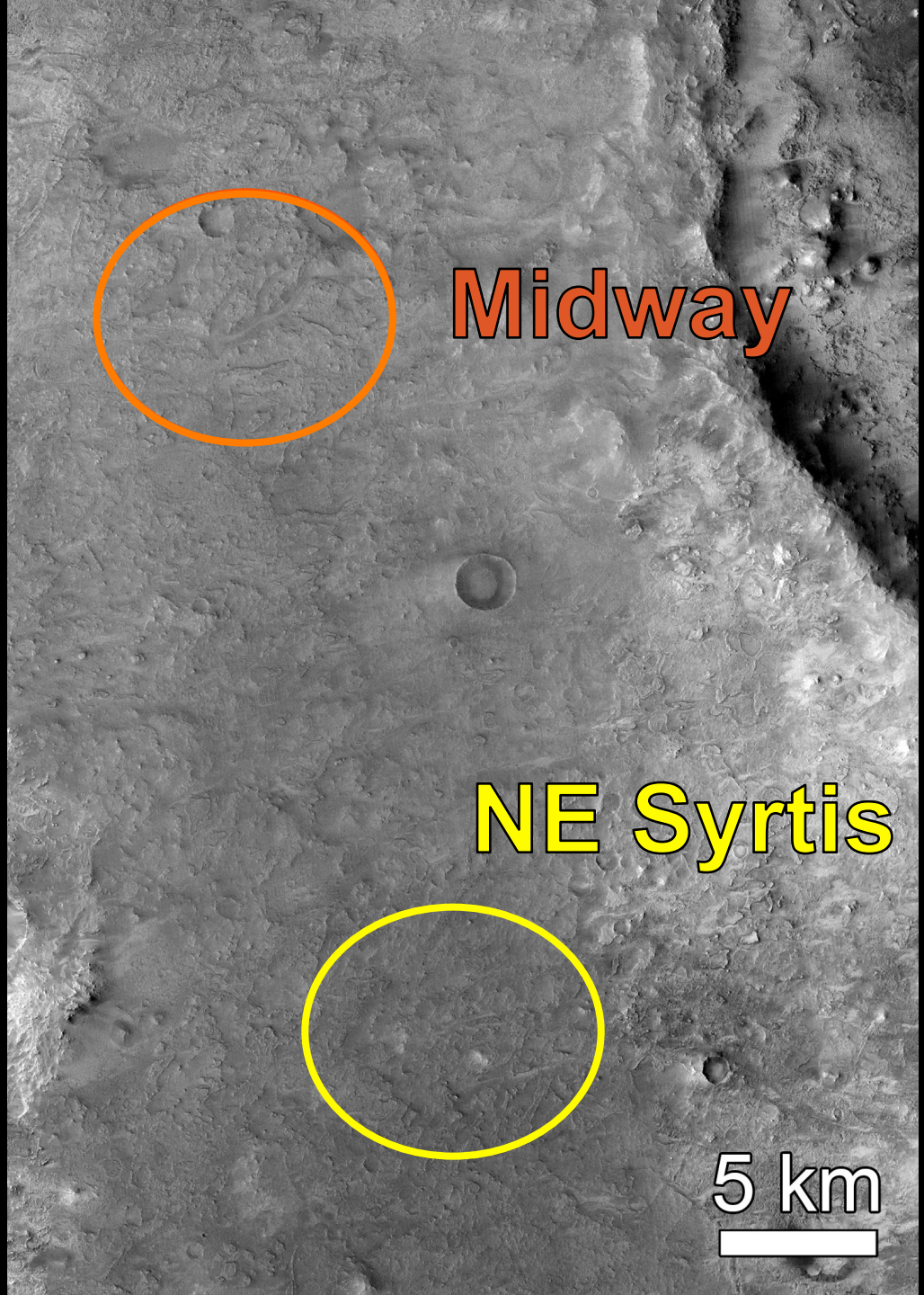
Mike Bramble, Jack Mustard, and Chris Kremer

BROWN

NSERC CRSNG

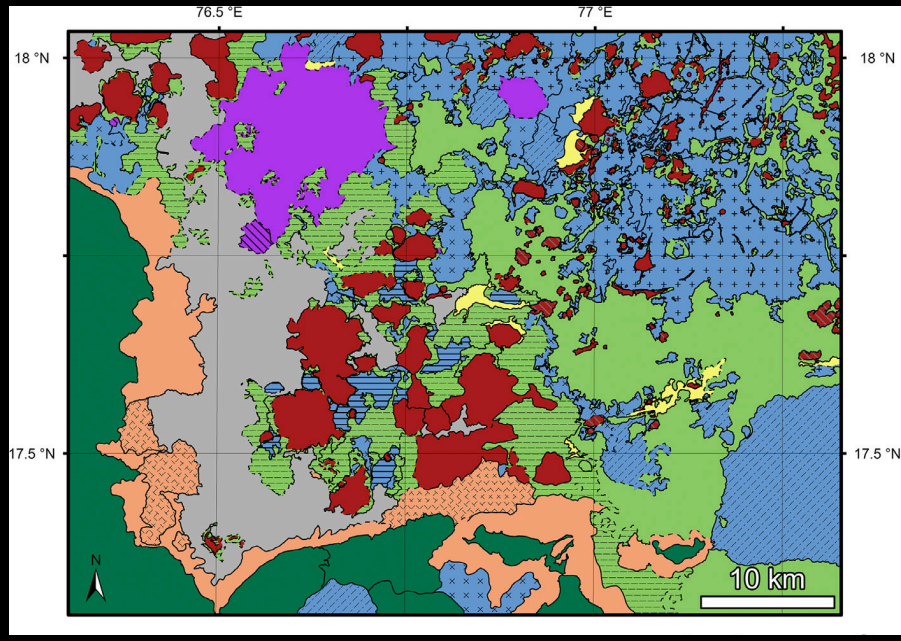
Motivation

- *Classify* surface exposures at Midway using the rubric of Bramble et al. 2017 for NE Syrtis.
- *Confirm* surface exposures at Midway
- *Compare* only <u>in-ellipse</u> exposures and science between Midway and NE Syrtis
- *Focus* on Large Linear Features



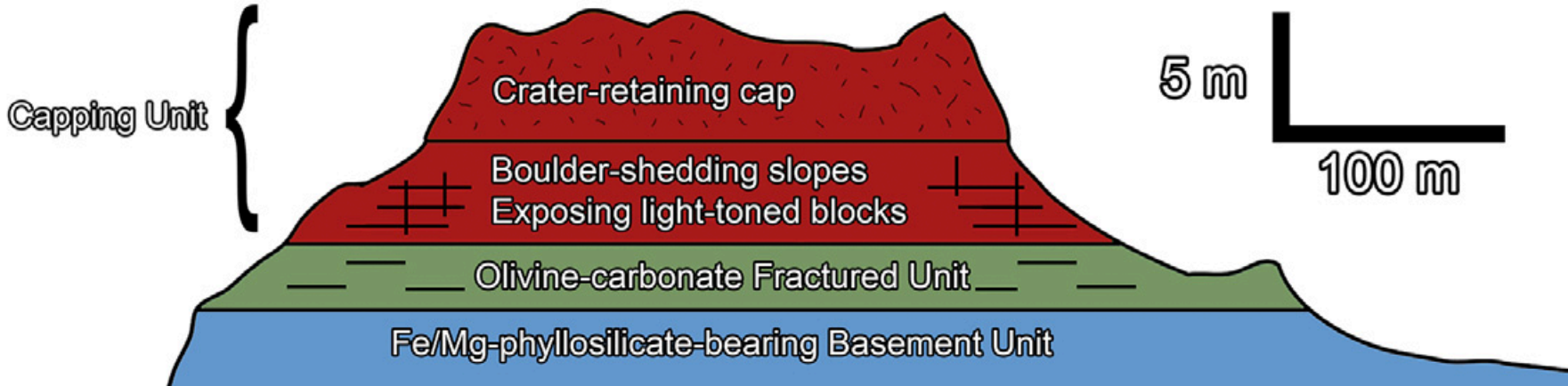
NE Syrtis Review

- Surface geomorphology classification using HiRISE basemap at 1:1000 scale
- Correlation of CRISM mineral signatures to HiRISE geomorphic units
- Despite seeming highly complex, NE Syrtis ellipse area can be unified into 3 Major units comprised of 10 subunits total



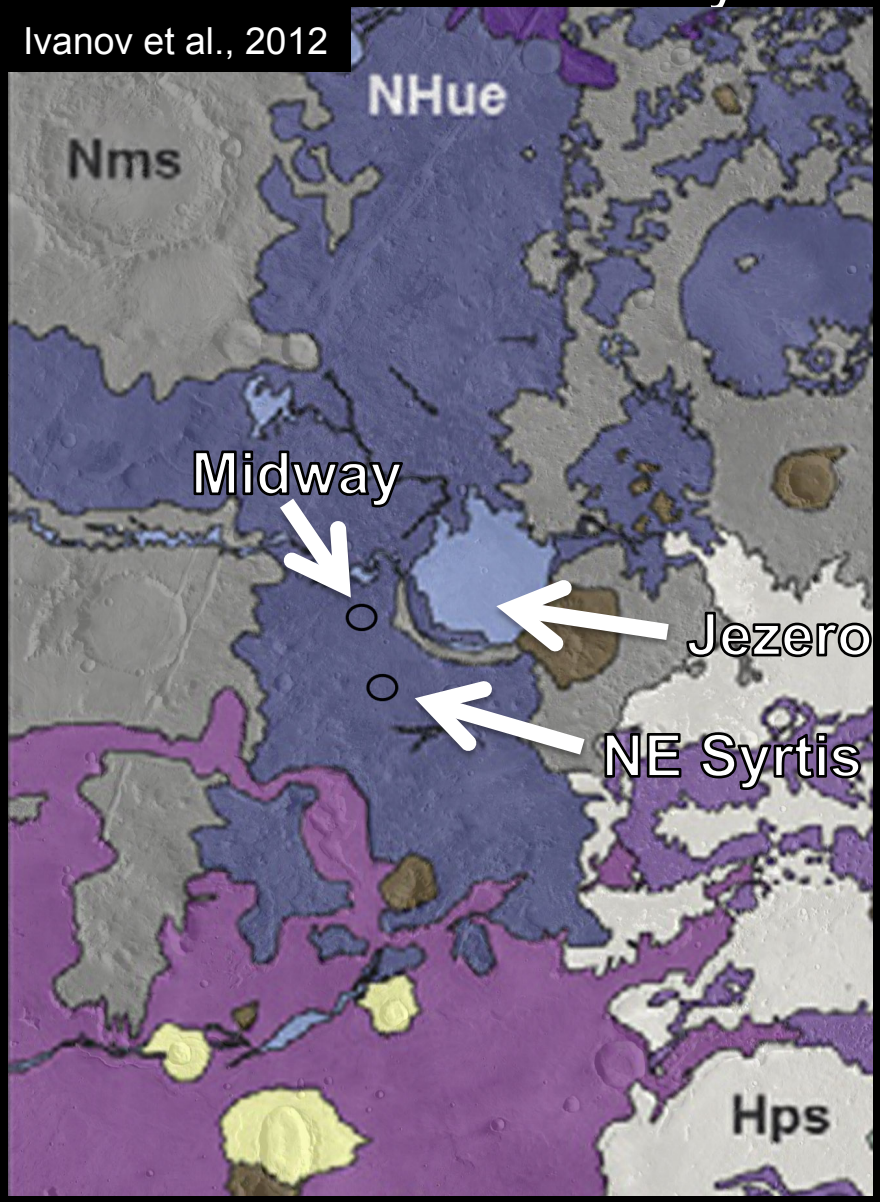
Bramble et al., 2017

In absence of Full-Resolution Targeted CRISM observations, correlated spectral units with HiRISE may offer a way to probe surface outcrops at Midway



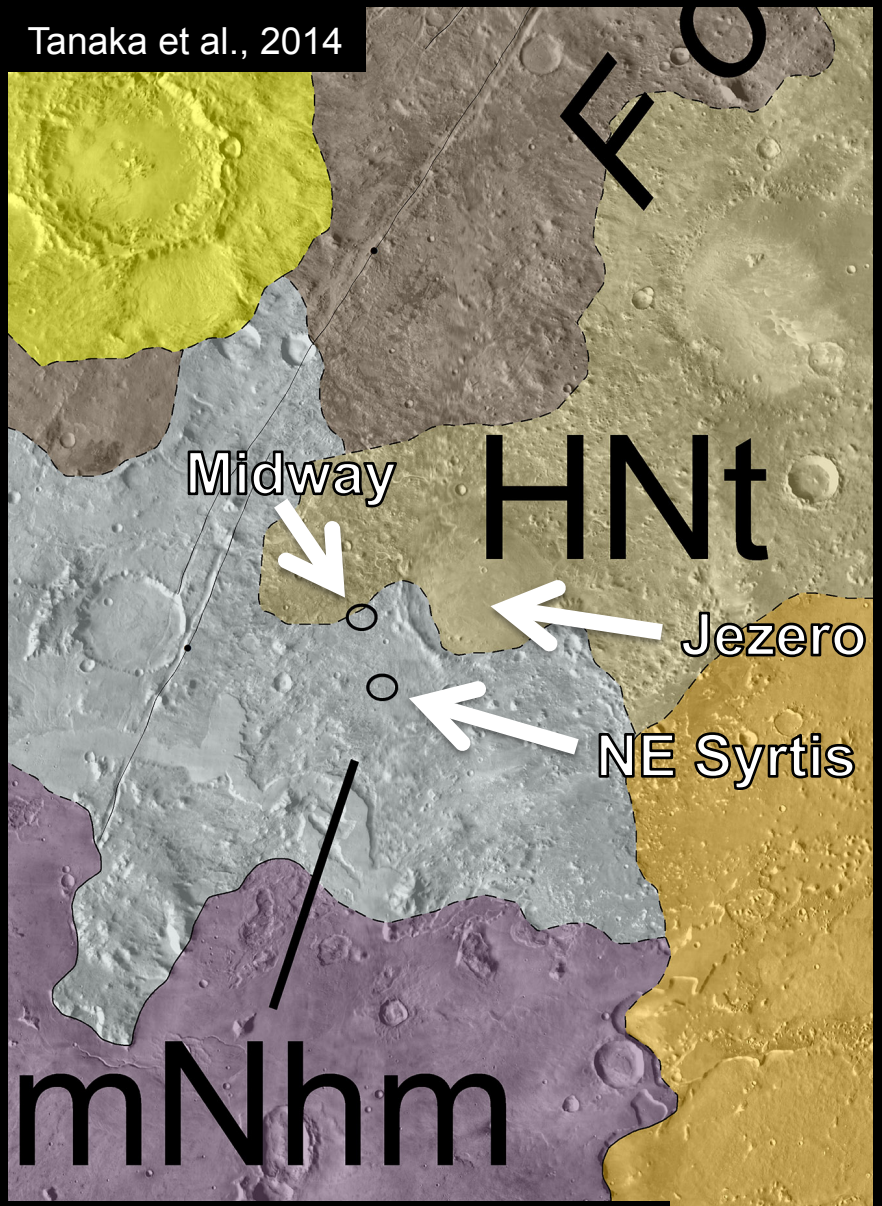
Broader Context of Midway

Ivanov et al., 2012



Noachian and Hesperian etched upland materials

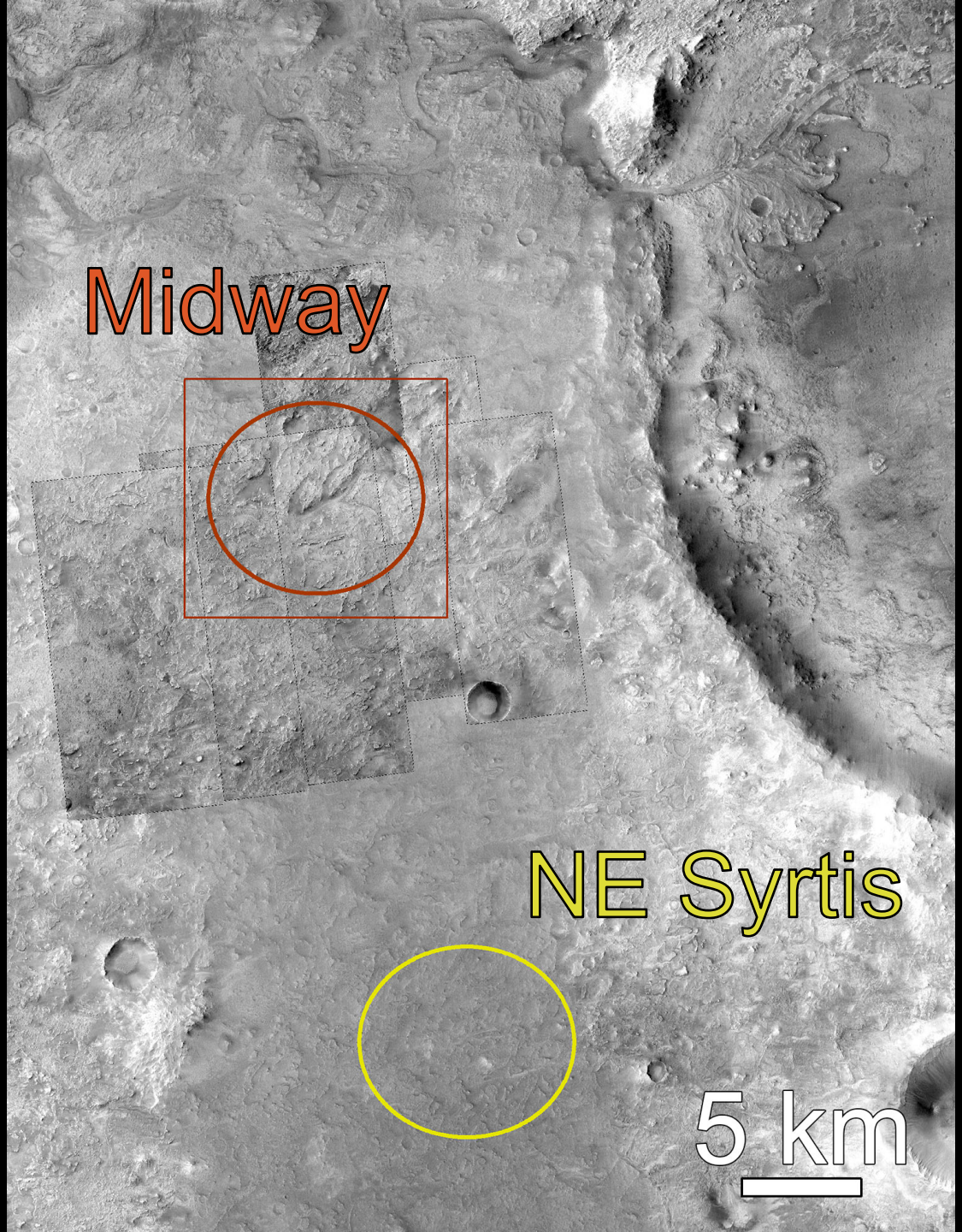
Tanaka et al., 2014



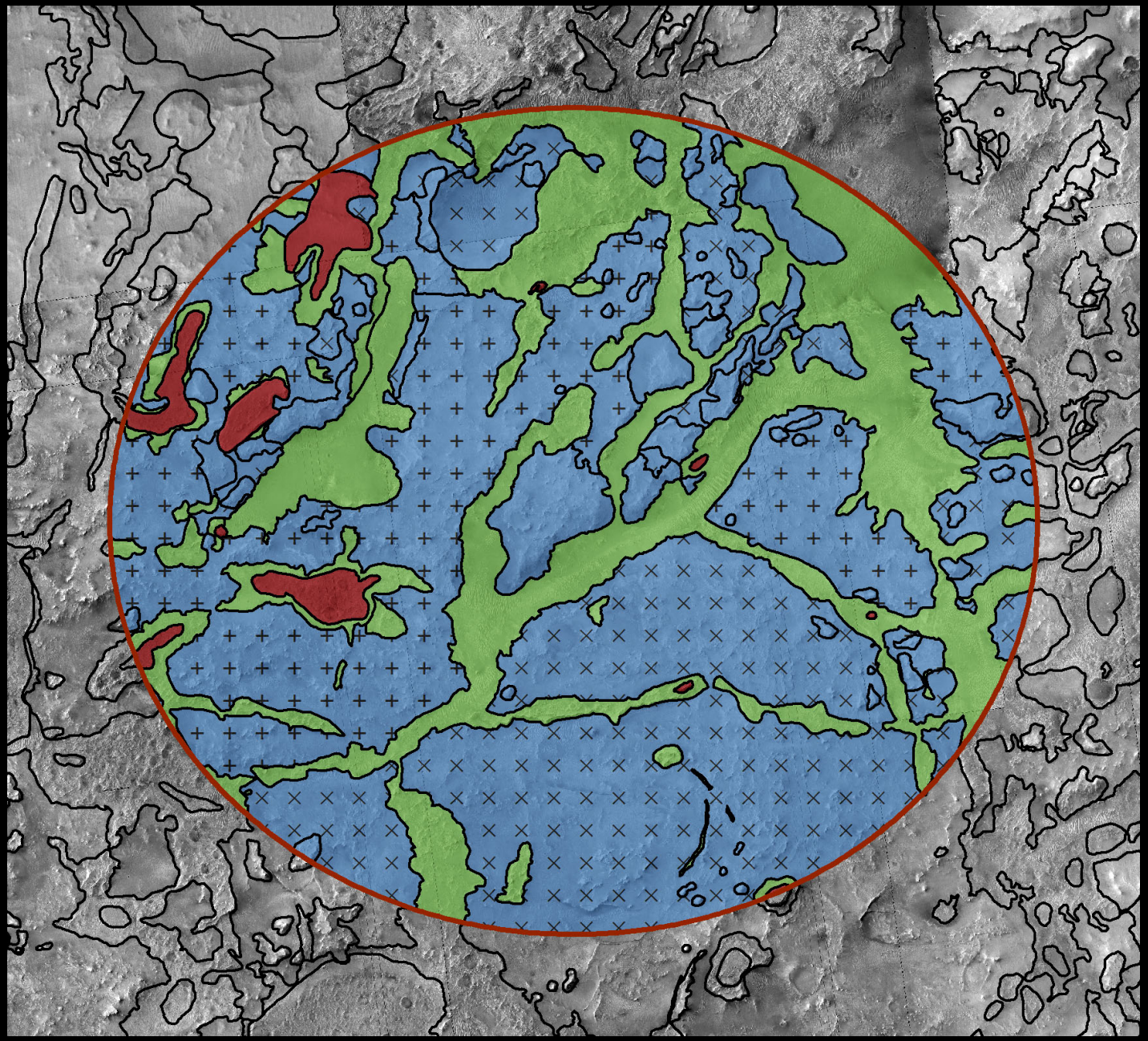
Middle Noachian highland massif unit

Ancient, degraded crustal rocks uplifted by large, basin-forming impacts.

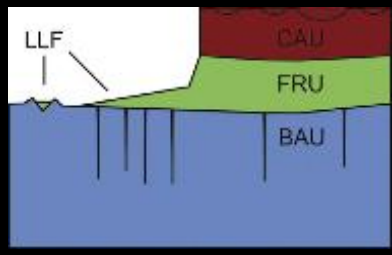
Methods

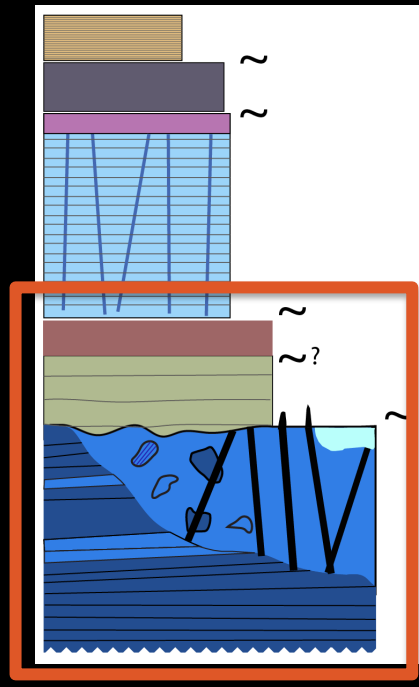


Midway – Geomorphology



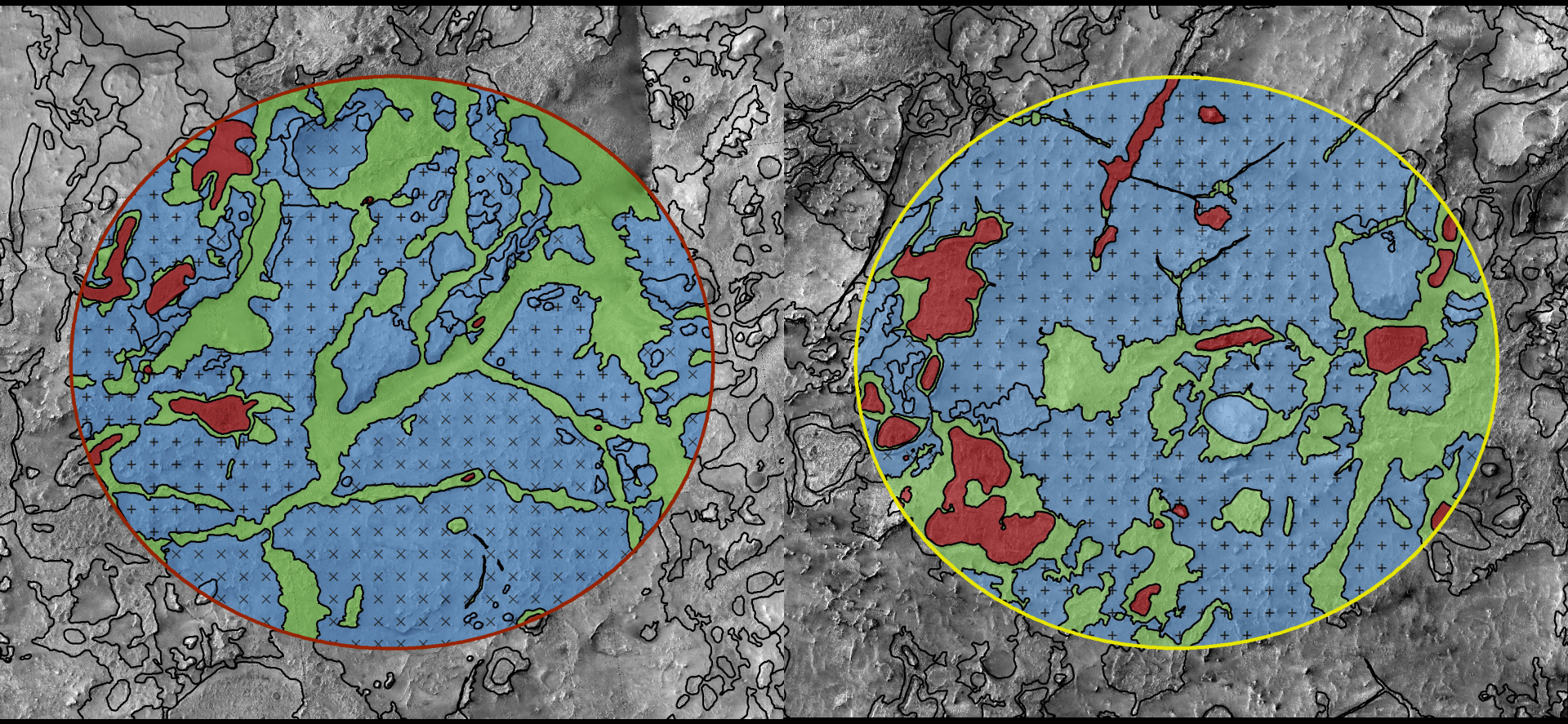
Capping Unit
Fractured Unit
Crustal Mounds
Knobby Plains
Smooth Plains





Midway

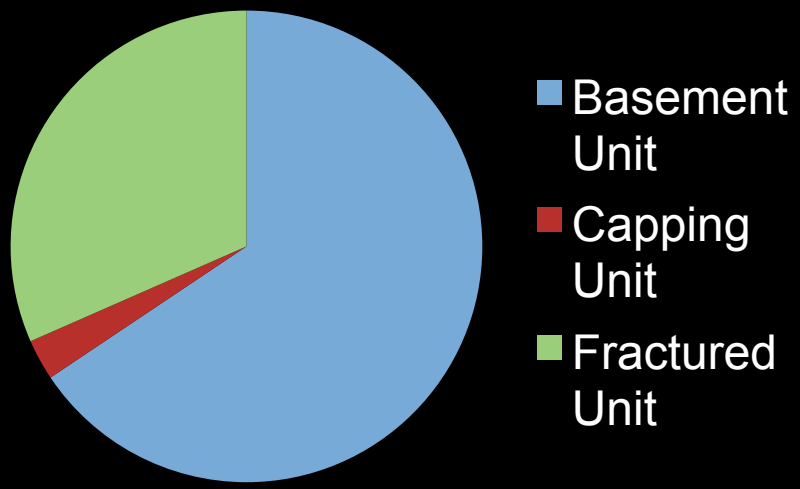
NE Syrtis



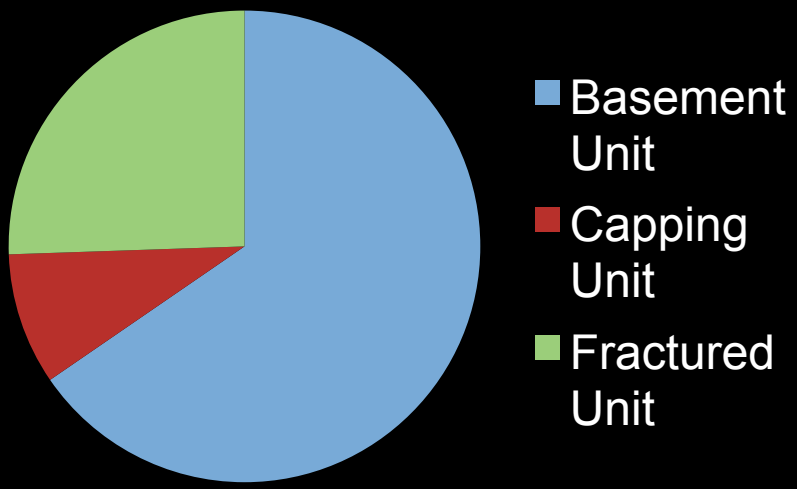
At HiRISE to CTX scale, Midway and NE Syrtis have remarkably similar coverage of surface units

Comparison of outcrop areas

Midway



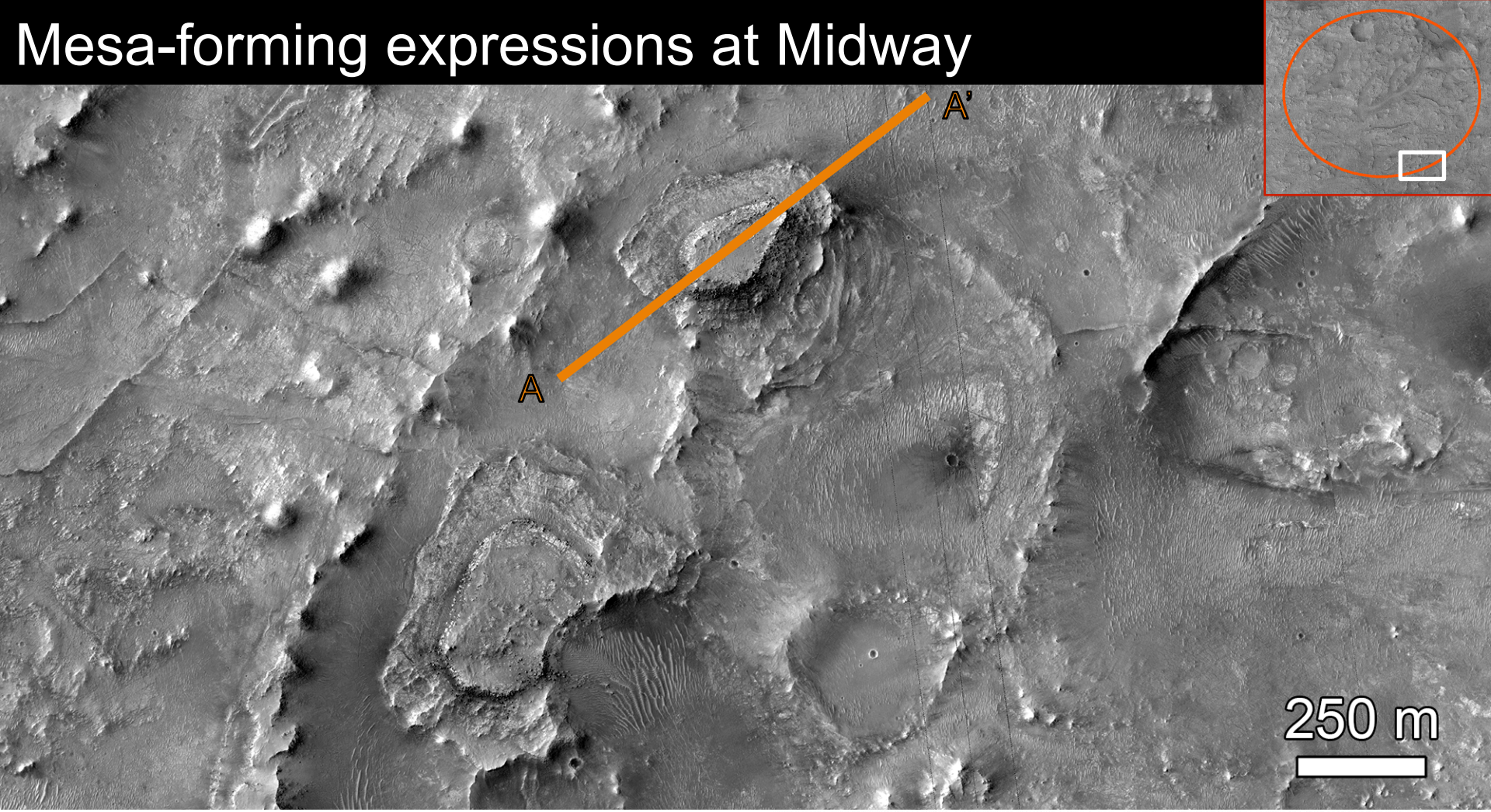
Northeast Syrtis Major

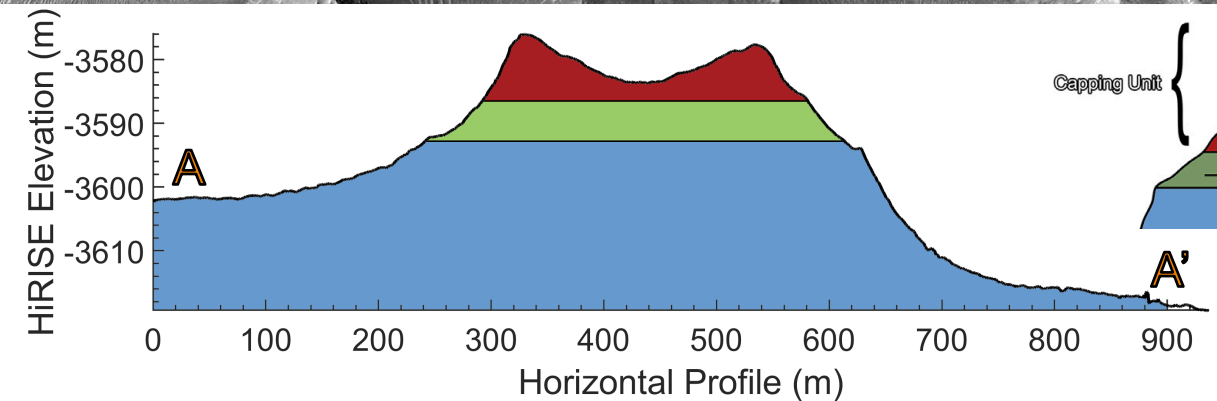


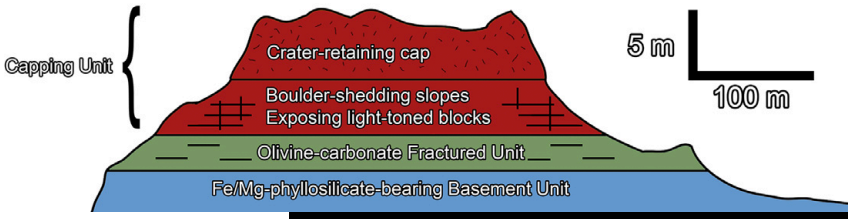
Using major unit groupings of Bramble et al. 2017

Fractured Unit includes Large Linear Features, and Basement Unit includes Crustal Mounds, Smooth and Knobby Plains

Mesa-forming expressions at Midway



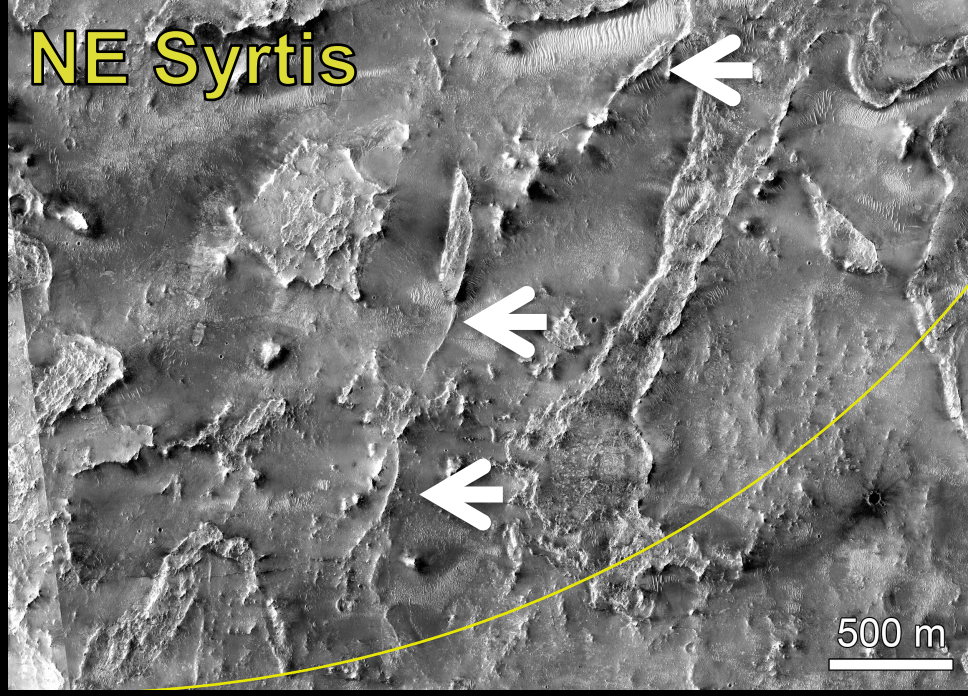


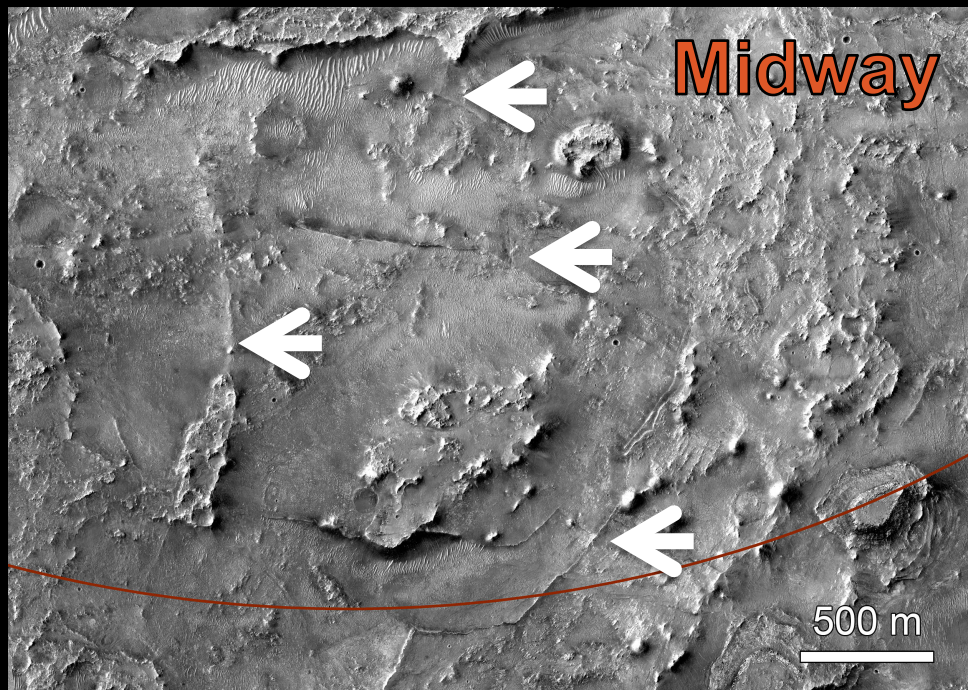


Basement reference section

Basement Ridges

- Rectilinear features high-standing above smooth basement. Meters in width and 100s of meters in length.
- Interpreted to be mineralized fracture zones.
- Similar abundance at both sites.
- Commonly observed terminating at the olivine-rich unit.

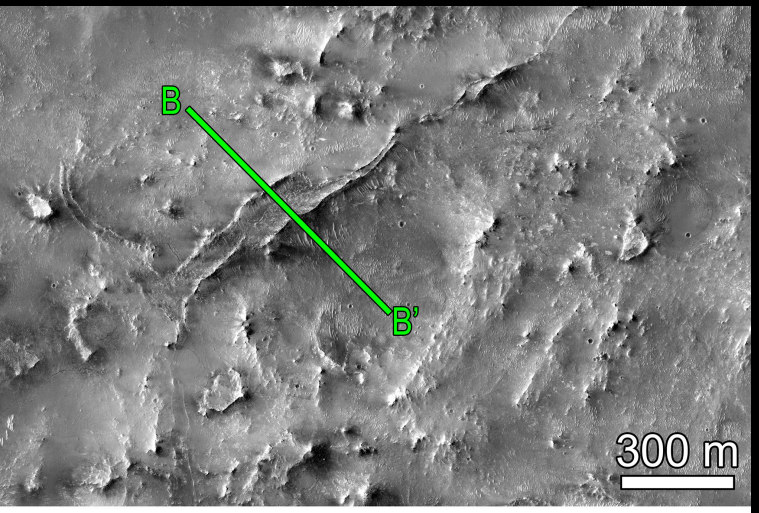


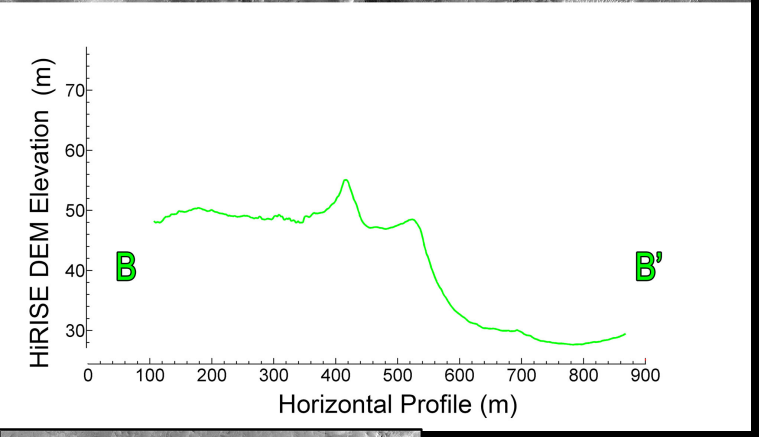


Saper and Mustard, 2013; Pascuzzo et al., in press

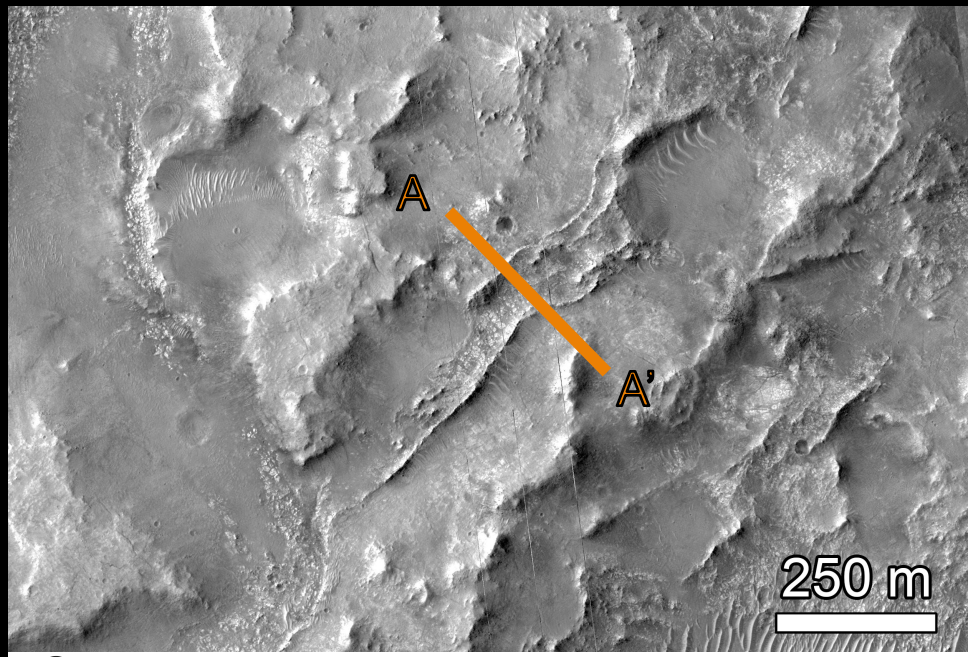
Raised Bounding Ridges

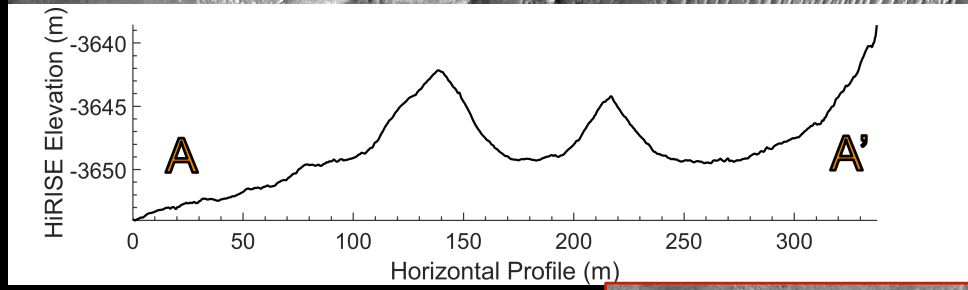
NE Syrtis

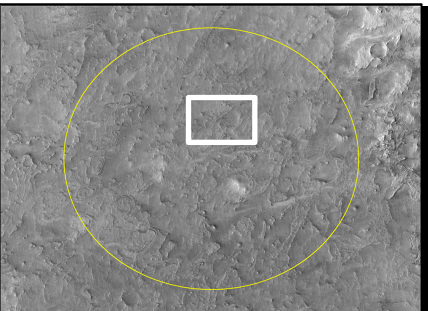




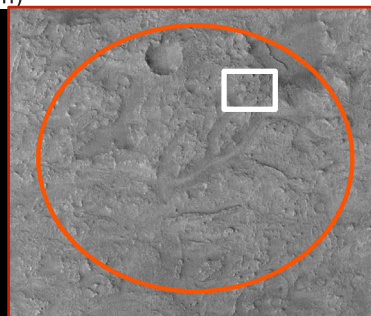
Midway



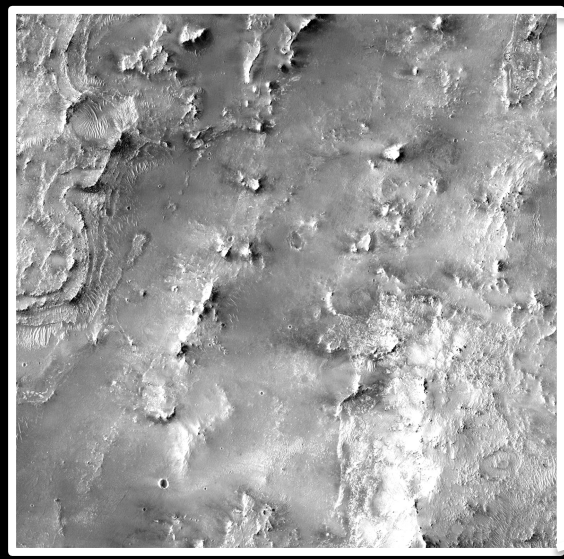


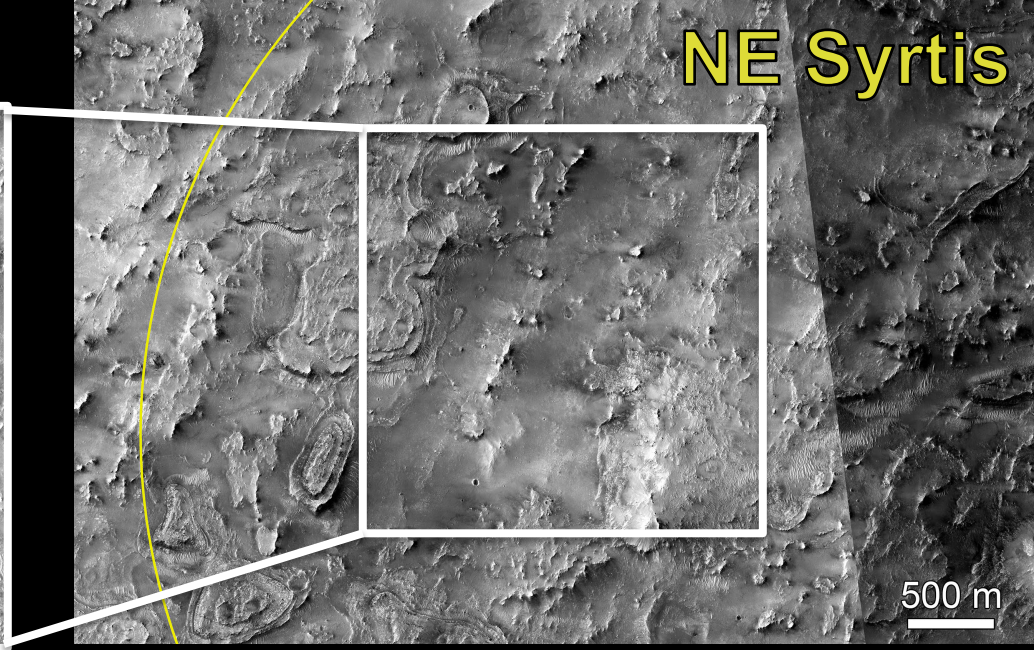


High-standing ridges with sharp contact with the basement, bounding the olivine-enriched unit. Interpreted as possible zone of contact alteration or contact metamorphism.

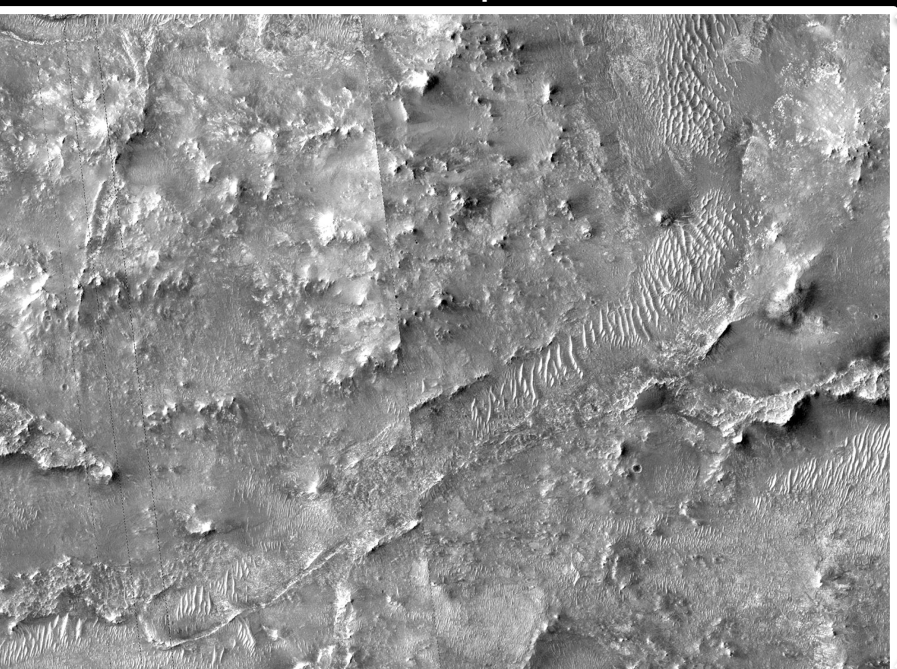


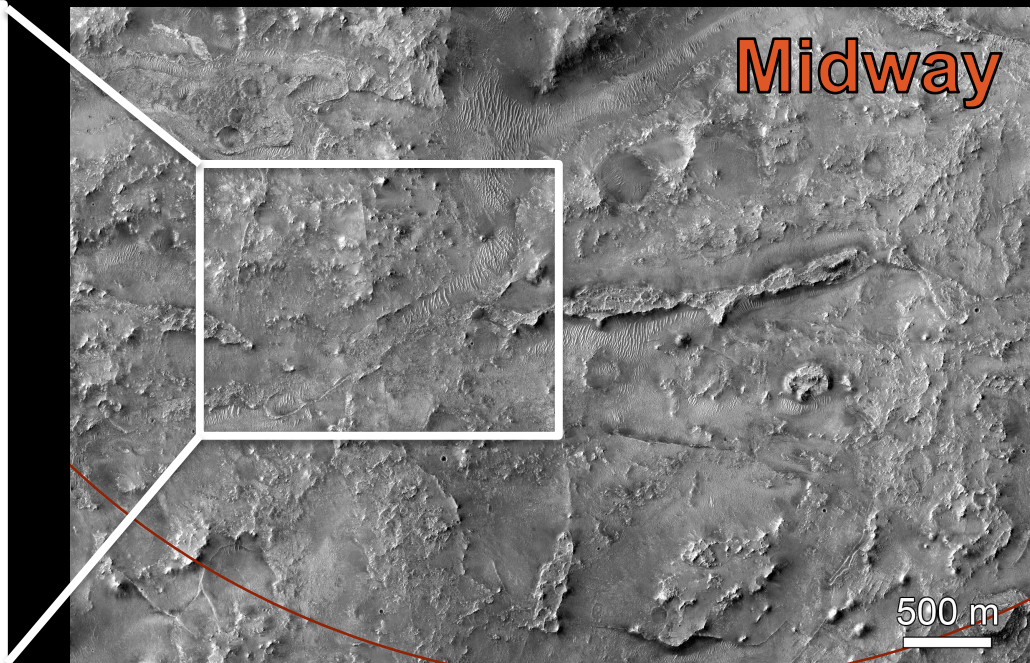
Surface alluvium cover





Midway displays lesser alluvium coverage leading to modestly better exposure of basement units, including megabreccia

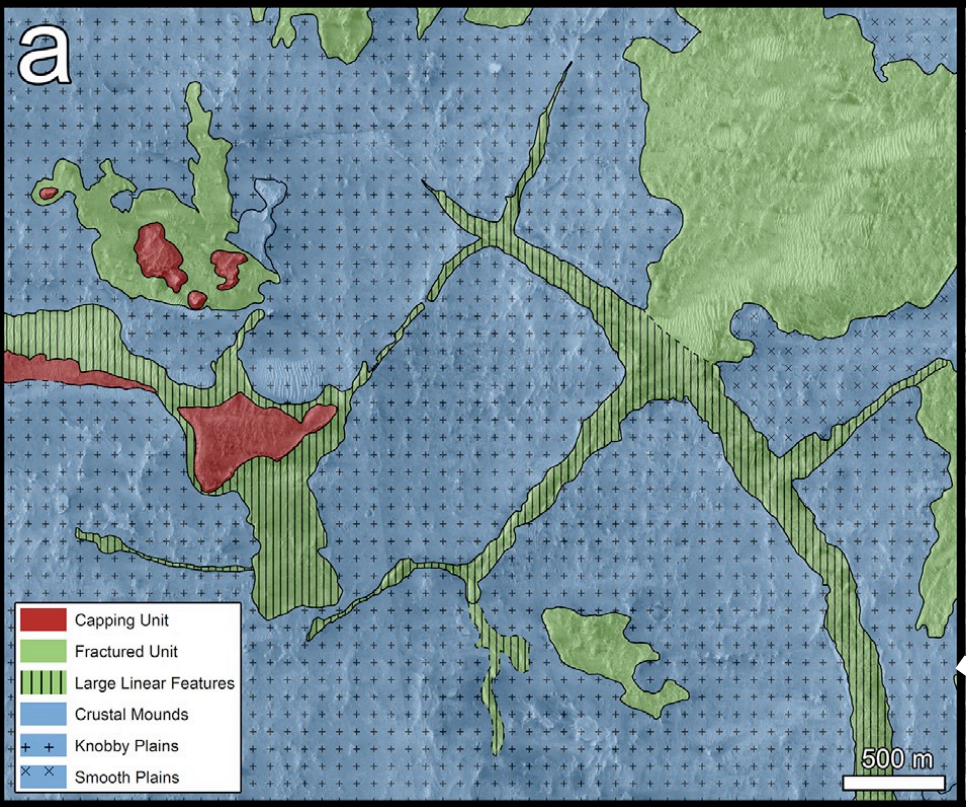


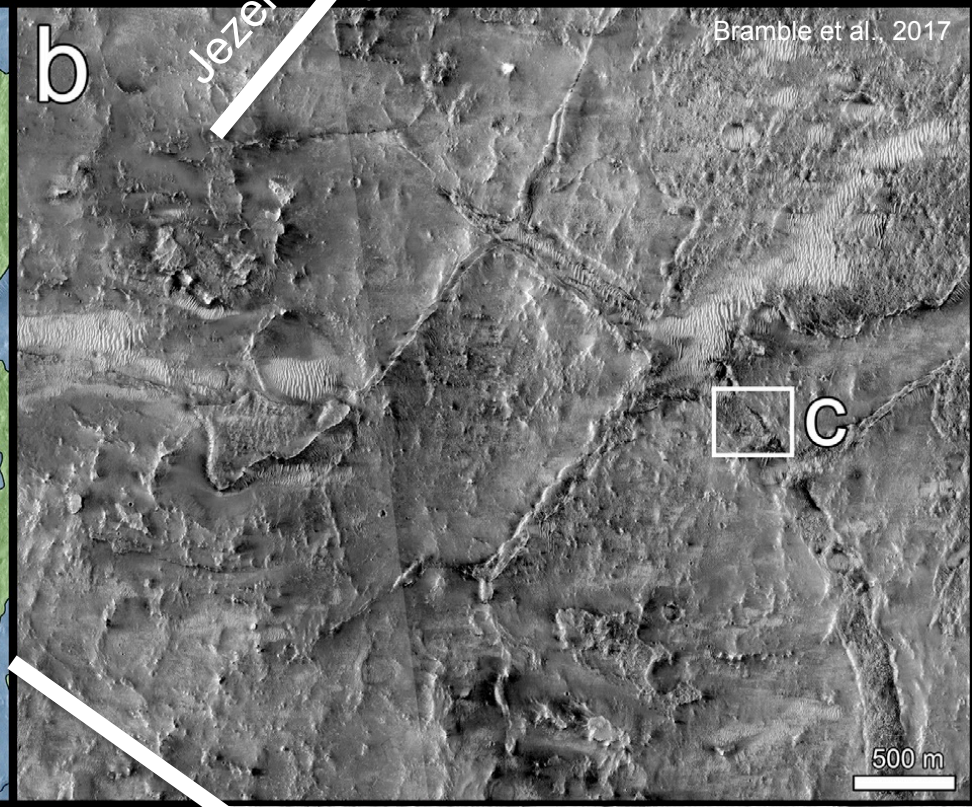


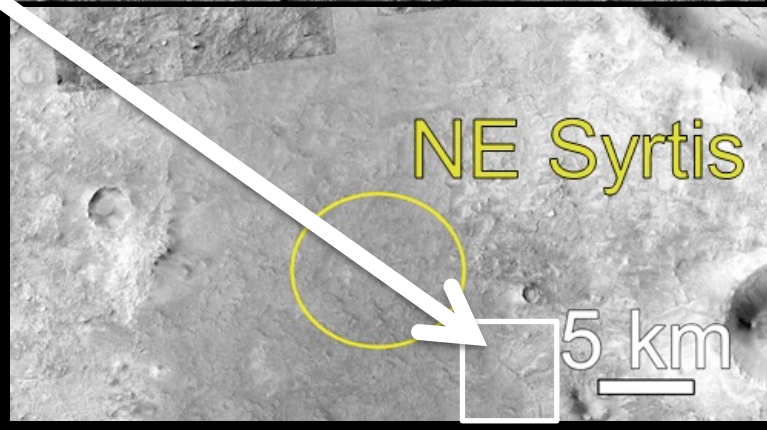
Focus on:

LARGE LINEAR FEATURES

Large Linear Features

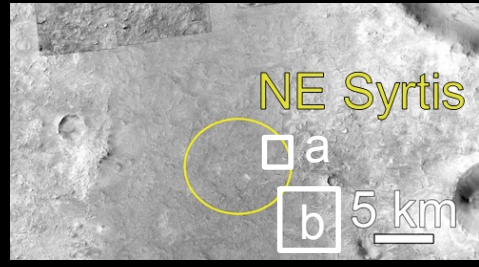


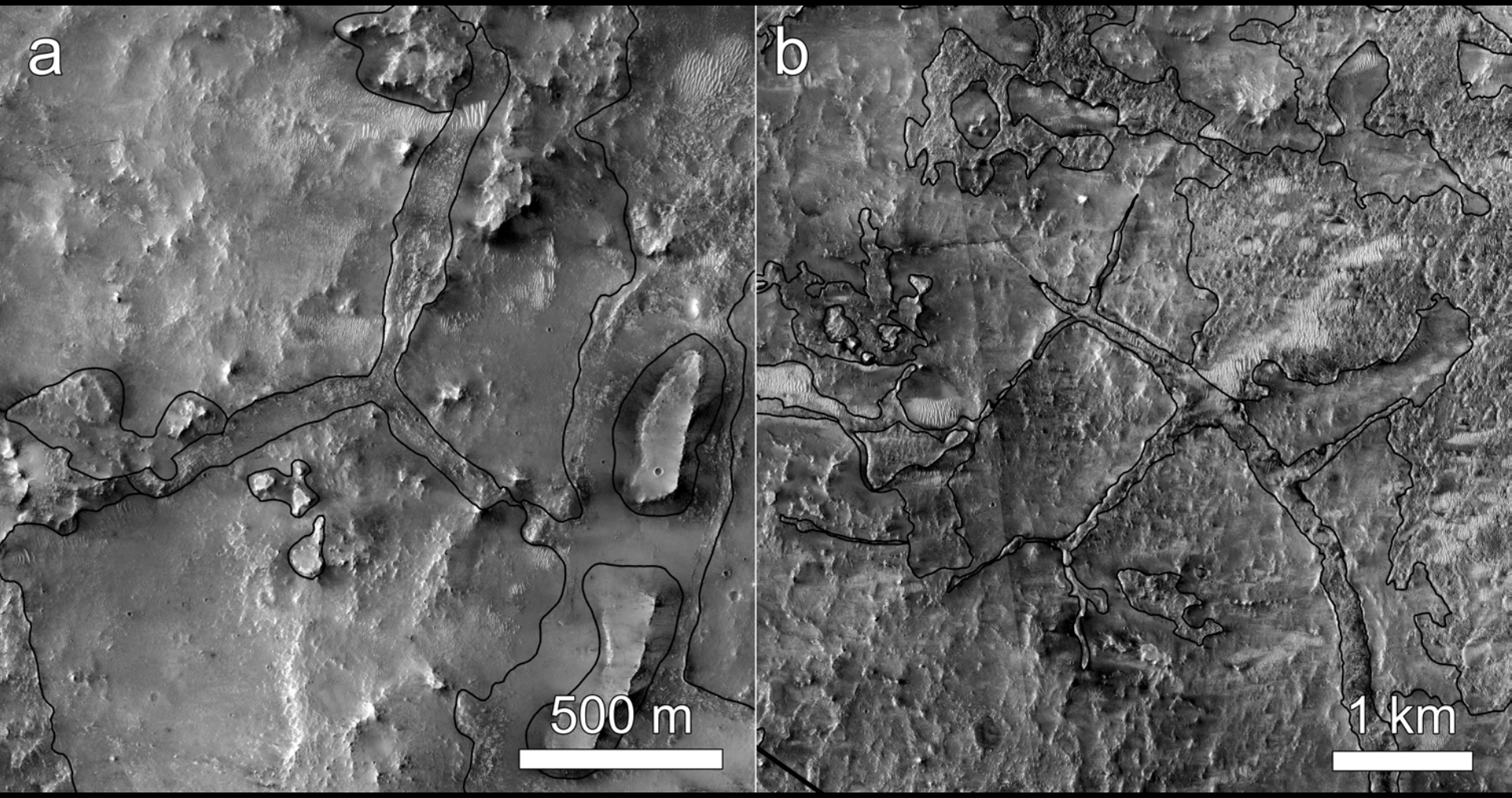




- Expressions of the olivine-enriched unit, 10–100s of meters wide, several kilometers long.
- Hypothesized to be mineralized fracture zones, material infilling troughs, yardangs, and/or breccia or igneous dykes [Bramble et al., 2017; Thomas et al., 2017].
- Radial to Jezero? Angular intersections?

Angular Large Linear Features Intersections



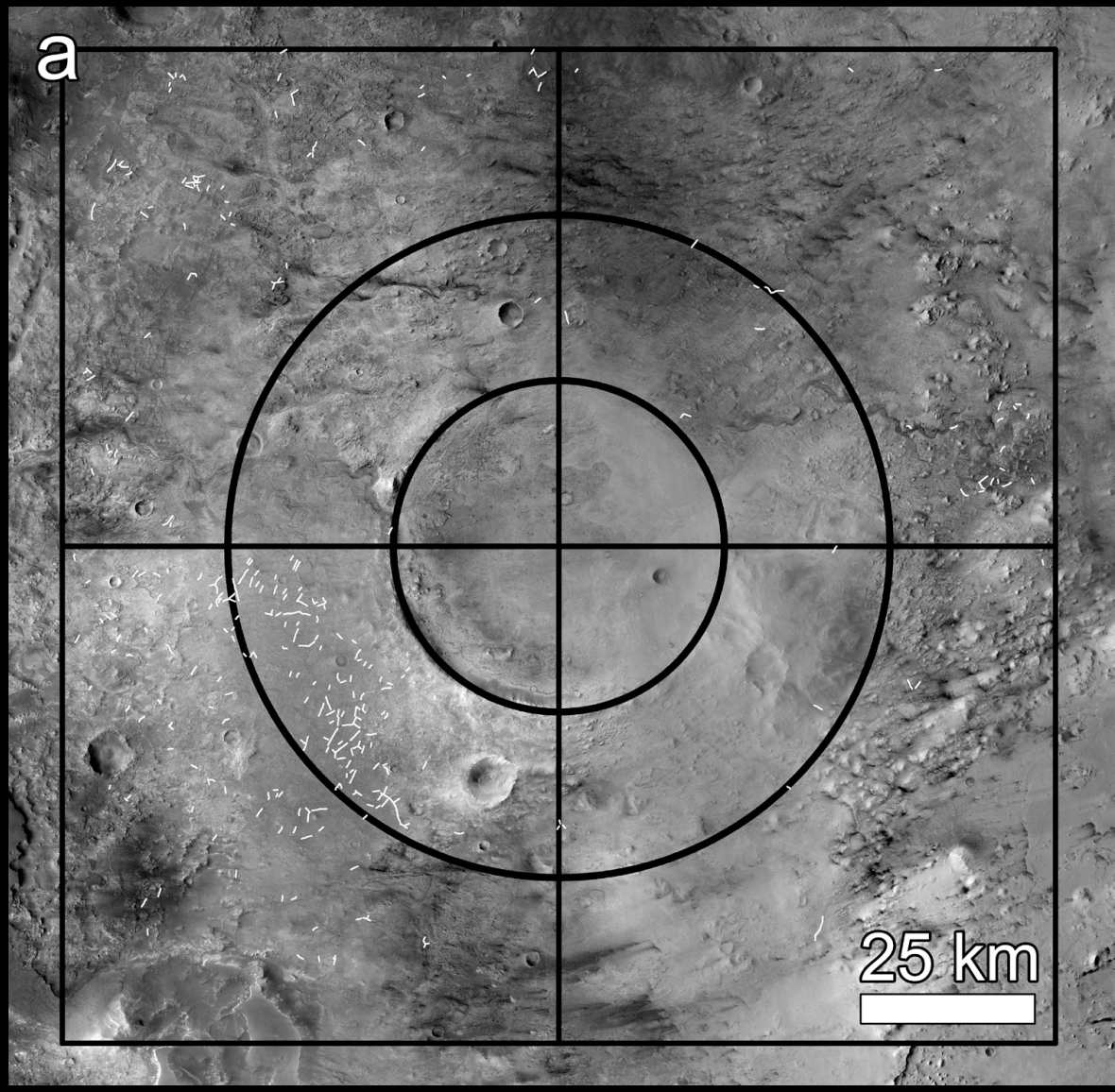


Subframes of HiRISE imagery from greater NE Syrtis region showing (a) triple and (b) orthogonal intersections in the LLF.

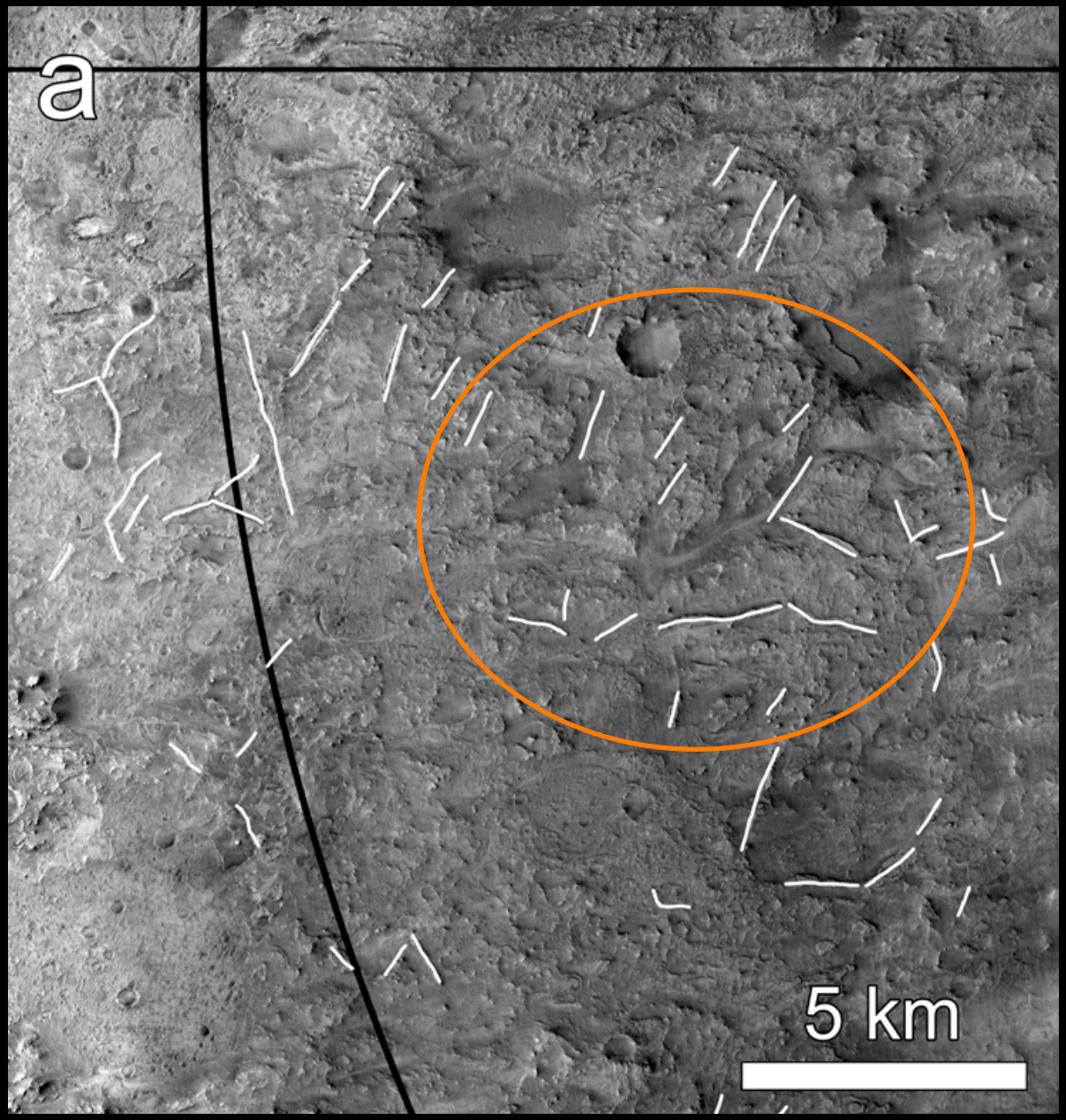
Survey of Large Linear Features Orientations

Surveyed LLF in a square 6 Jezero radii across centered on Jezero using CTX imagery.

Mapped LLF if:
(1) previously identified in literature as LLF, or
(2) If a feature >500 m matched LLF characteristics.



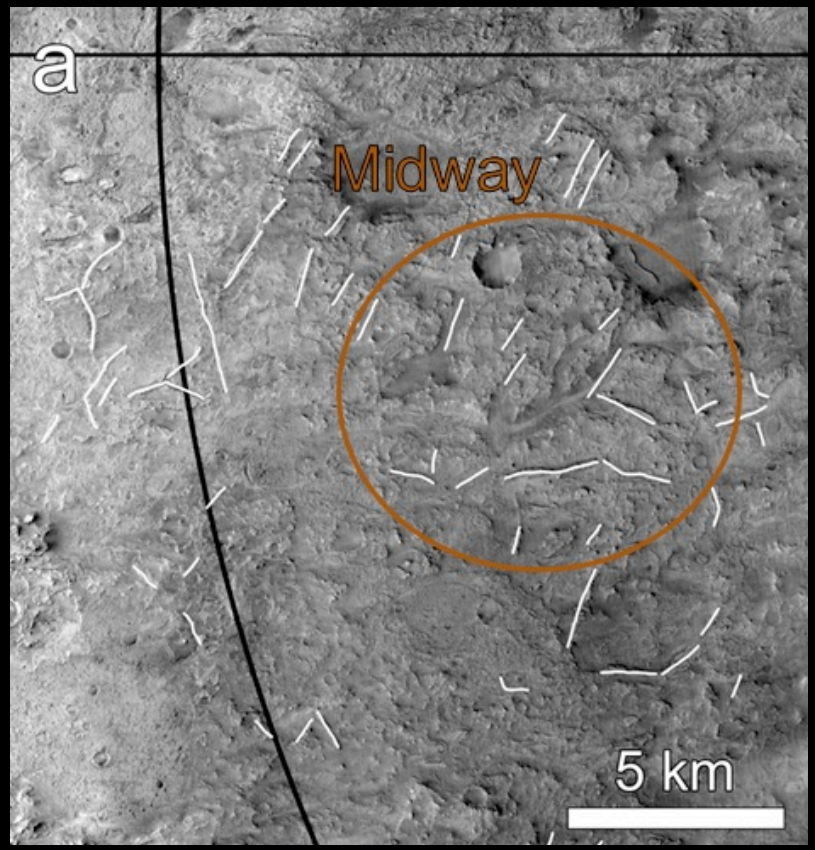
Large Linear Features

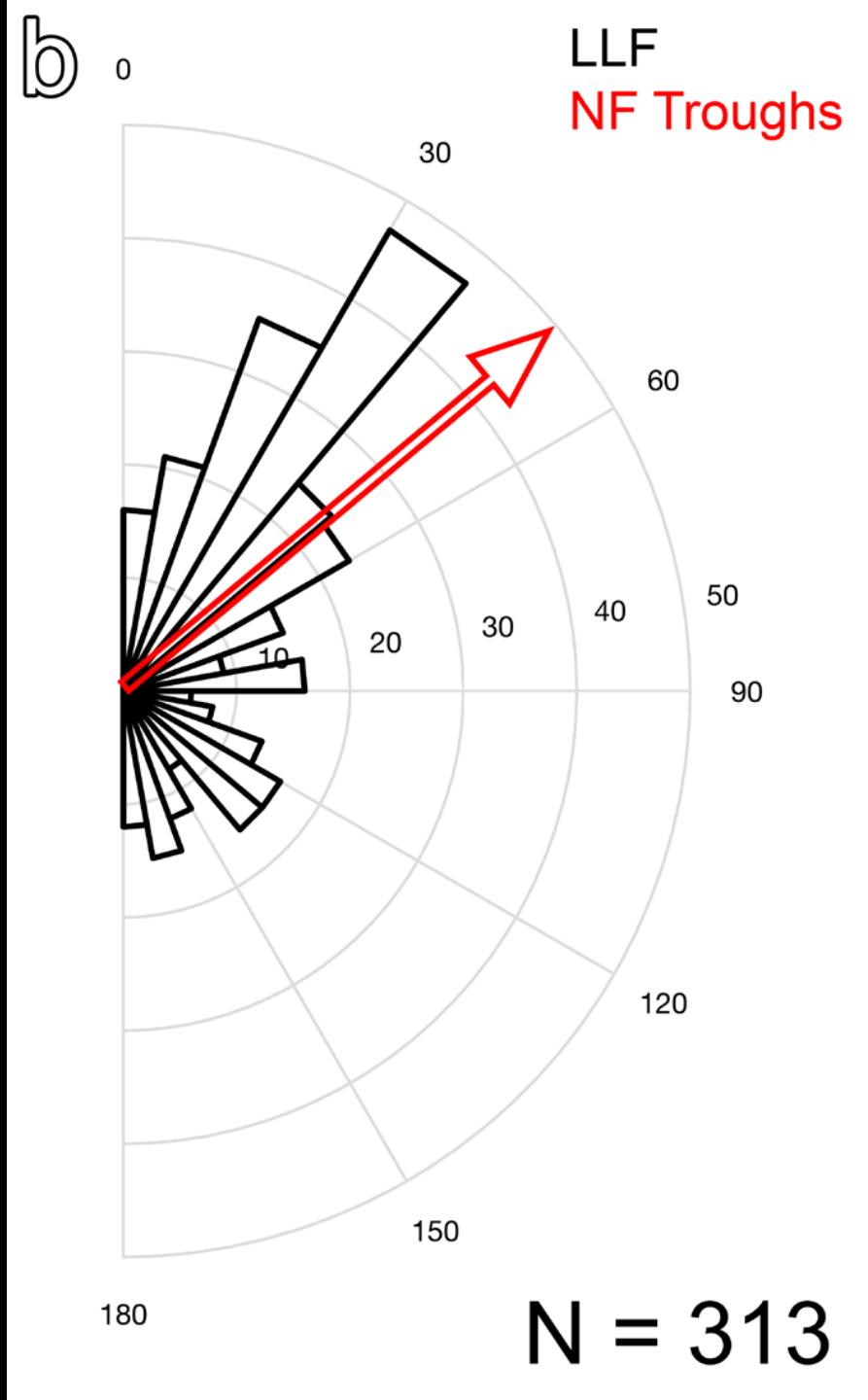


Jezero

Midway

NE orientated LLF distinctly not radial to Jezero crater (to right of frame).



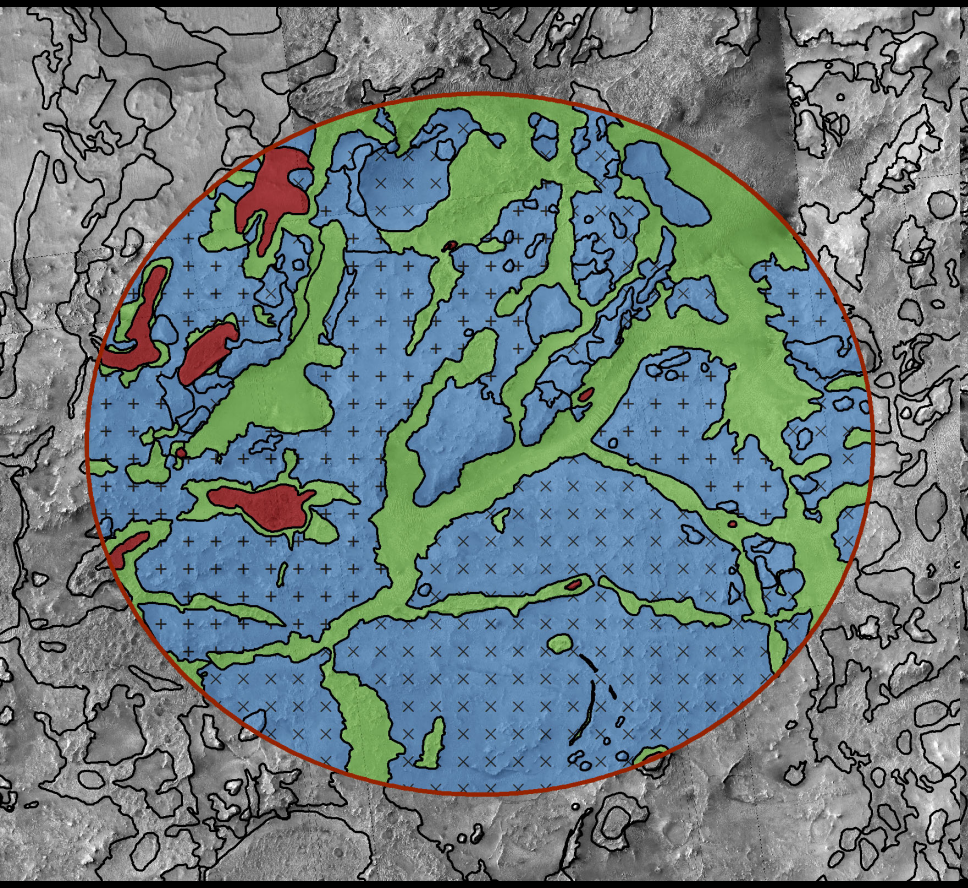


Large Linear Features are therefore…

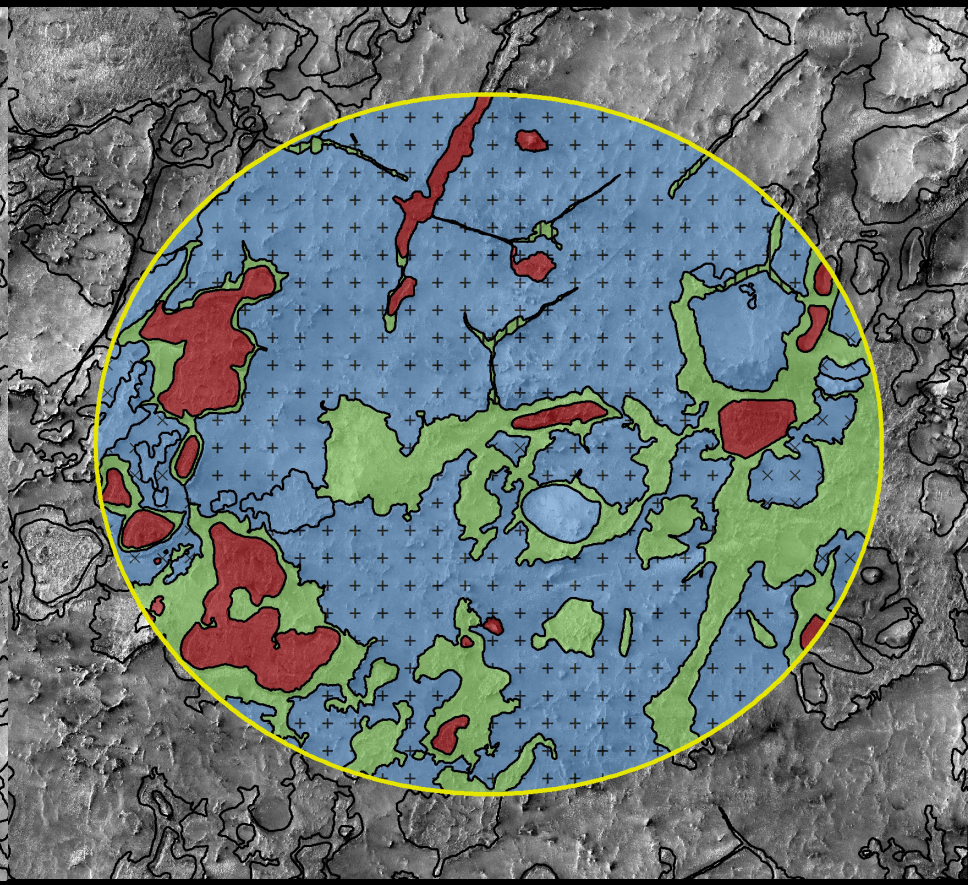
…best explained by infilling of fractures formed from regional stresses related to the Isidis basin and the Nili Fossae, and by deposition and induration of a clastic olivine-enriched unit.

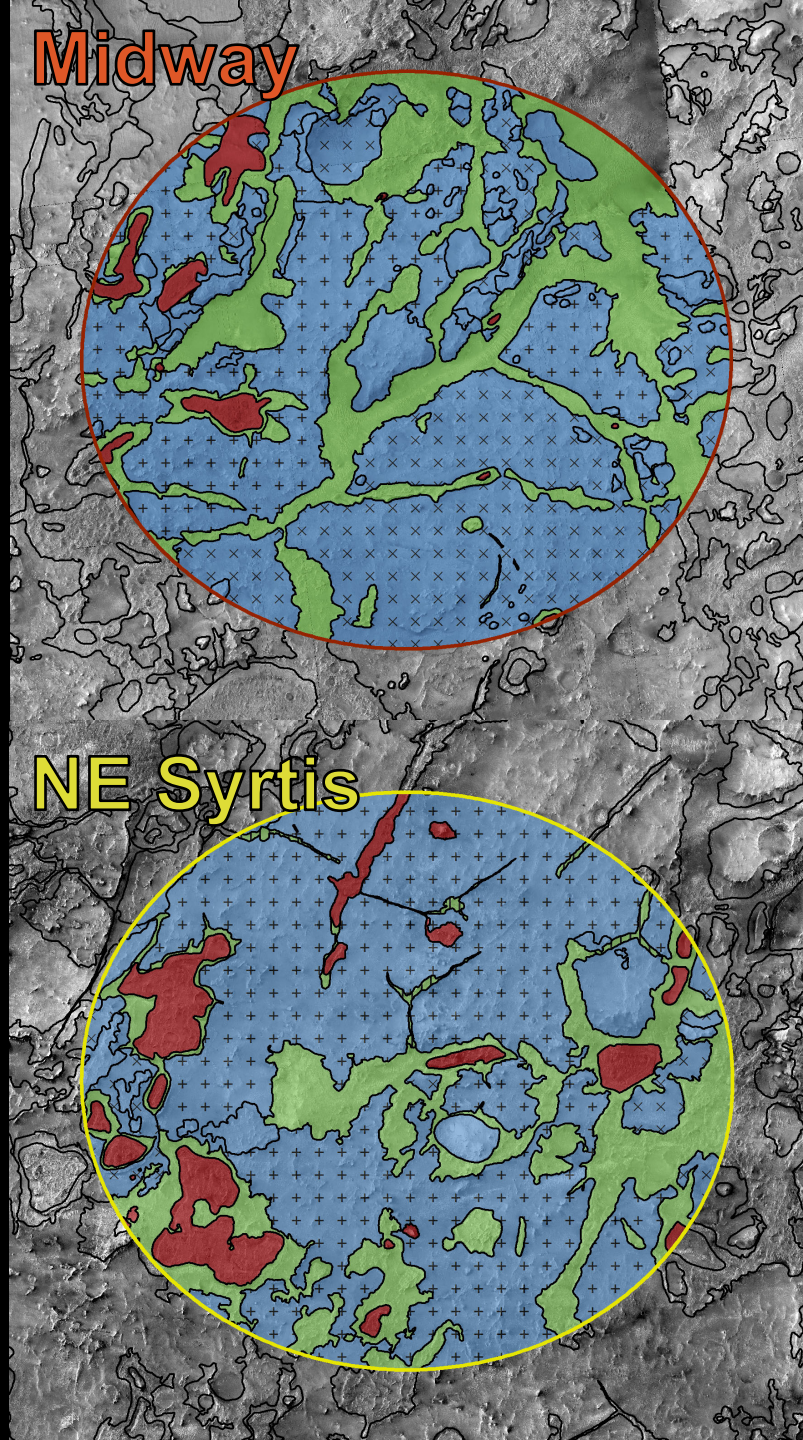
Large Linear Features at Midway and NE Syrtis

Midway



NE Syrtis



Major Takeaways

- Midway and NE Syrtis have highly similar coverage of surface units as classified and mapped at HiRISE to CTX scale.
- Main geomorphic features highlighted for NE Syrtis are present at both sites.
- Midway provides modestly better access to megabreccia outcrops due to a less intense alluvium cover, and similar access to raised basement ridges and mesa structures.
- The Large Linear Features are a captivating target to explore the interaction zone between the Nili Fossae basement, deformation of the Isidis Basin, and emplacement and alteration of the olivine-enriched unit.